EIP Bulletin

TENNESSEE EMERGING INFECTIONS PROGRAM

Tennessee Department of Health Communicable and Environmental Disease Services — August 2006

Petting Zoos: What's All the Stink?

While some diseases affect only specific species, many other diseases can be spread between different animal species, including humans and animals. These diseases are collectively known as zoonotic diseases. Zoonotic diseases can be transmitted by a variety of routes. Some documented ways include direct and indirect contact with infected animals, airborne exposure to infective agents shed by animals, consumption of animal products, or consumption of water that has been contaminated by animal fecal material.[1]

Agricultural fairs and petting zoos permit the public to come into contact with animals which can carry a host of human pathogens. Among these pathogens are *Salmonella* and *E. coli* 0157:H7. The CDC estimates that *E. coli* O157:H7 causes 73,000 illnesses, 2,100 hospitalizations, and 61 deaths in the United States every year. It is estimated that *Salmonella* causes 1.4 million illnesses annually in the United States resulting in 500 fatalities. Both *E. coli* O157:H7 and *Salmonella* infections can be transmitted by contaminated food, water and contact with fecal material from infected persons or animals. Animals infected with enteric pathogens often show no indicators of illness and might shed pathogens intermittently. Outbreaks of disease associated with contact with animals in exhibition venues highlight concerns for disease transmission to the public. A recent literature review identified > 25 human infectious disease outbreaks during 1990 – 2000 associated with visitors to animal exhibits.[2]

To describe human behaviors

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Sorting Out "Shiga-toxin Producing *E. coli*"

Escherichia coli is a ubiquitous Gram-negative bacteria commonly encountered in clinical practice. Most *E. coli* are non-pathogenic residents of the colon. "Extraintestinal pathogenic *E. coli*", or ExPEC, is the most common cause of urinary tract infections, and can cause a plethora of other extraintestinal infections.

E. coli is a common cause of diarrhea worldwide. Several *E. coli* strains cause diarrhea via different mechanisms, and the various acronyms by which they are referred can be quite confusing (Table). Many of these pathogens are of particular importance in developing countries. Except for Shiga-toxin producing *E. coli*, routine culture methods do not identify these organisms.

Shiga-toxin producing *E. coli*, also referred to as "STEC" (of which enterohemorrhagic *E. coli* [EHEC] is a subset) are an important cause of sporadic and outbreak-associated diarrhea in the U.S. By definition, STEC strains produce Shiga-toxins (also called verotoxins), one of which is essentially identical to a toxin produced by *Shigella dysenteriae* (hence the unfortunate, confusion-inducing nomenclature). STEC strains can cause watery or bloody diarrhea and hemorrhagic colitis. Nausea, vomiting and fever are relatively uncommon. Of those infected, 5-10% may develop hemolytic uremic syndrome (HUS), which disproportionately affects young children and the elderly and can have a mortality rate of up to 5%.

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Petting Zoos: What's All the Stink? (continued)

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that impact fecal-oral transmission of pathogens in animal settings, data regarding behaviors, hand hygiene and environmental contamination were collected at petting zoos in middle Tennessee. Visitors were observed for animal contact, contact with environmental surfaces, hand-to-face contact (i.e. mouth, nose, eyes), eating or drinking, and hand sanitizer use. Environmental samples were collected from soil, livestock feces, bedding, and surface swabs. In order to assess hand hygiene, hand-wipes were distributed to randomly selected visitors upon exiting the petting zoo. Both environmental samples and hand-wipes were analyzed for *E. coli* O157 and *Salmonella*.

Behaviors were observed in 991 visitors to 6 petting zoos in middle Tennessee. Overall, 49% of visitors touched their face while in the petting zoo; 87% came in contact with an environmental surface and 74% touched animals. Eating or drinking was observed in 22% of visitors. Whereas, hand sanitizer use was observed in 1700 visitors upon exiting the petting zoo. Over half of the visitors 1054 (62%) did not use the hand sanitizer stations. However, substantial variation in hand sanitizer use (13% to 66%) was observed among venues (**Table 1**). Hand sanitizer use was influenced by a variety of factors. Petting zoos with visible, convenient, well-located (at exits) hand sanitizer stations had higher hand-hygiene compliance. The presence, visibility and readability of signs reminding visitors to wash hands, along with verbal reminders given by petting zoo operators to wash hands also increased hand sanitizer use.

Of 150 visitors whose hands were cultured, none grew *Salmonella* or *E. coli* O157. Of 56 environmental samples from 3 petting zoos, 21 (38%) were positive for *Salmonella*, and 2 (4%) yielded *E. coli* O157. Positive samples were collected from: calves, mules, sheep, goats, cows, and environmental surfaces (rails, benches, etc.), which accounted for 39% of the positives samples. The majority of positive samples were from one petting zoo (**Table 2**).

Visitors to petting zoos engage in a number of modifiable behavioral risk factors for disease transmission. Preventive measures targeting modification of human behaviors associated with fecal-oral transmission might reduce disease risks to visitors. Proper hand washing is the single most effective way to minimize the chance of acquiring an infection. Other measures such as avoiding hand-to-mouth activities (eating, drinking, smoking, use of pacifiers) along with carefully washing objects that have come into contact with the petting zoo environment are also important in preventing disease transmission.[2]

BY MARCY MCMILLIAN, MPH

FoodNet Epidemiologist

Table 1. Hand Sanitizer Use in Visitors by Petting Zoo

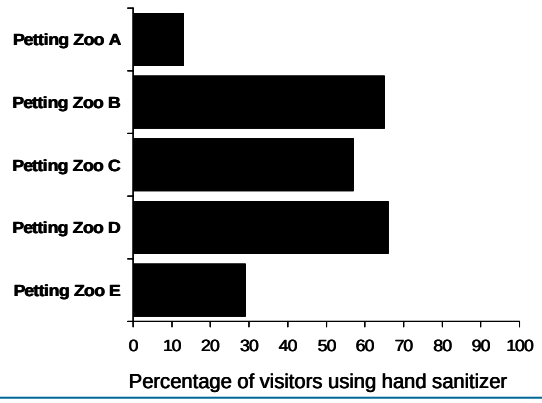
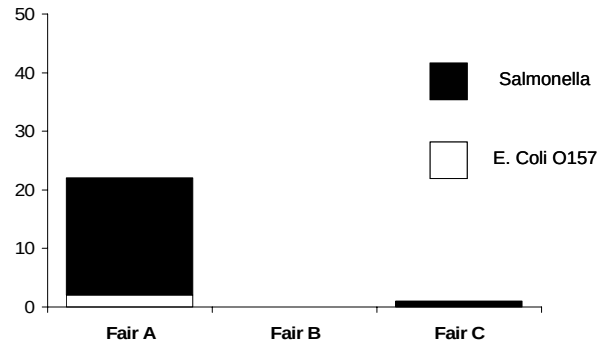


Table 2. Proportion of Positive Environmental Samples for *Salmonella* and *E. coli* O157



[1]Fair and Petting Zoo Safety, Zoonotic Disease. http://www.fair-safety.com Accessed July 26, 2005.

[2]Schuchat, A, Aguilar JR, et al. Compendium of Measures To Prevent Disease Asociate with Animals in Public Settings, 2005. National Association of State Public Health Veterinarians, Inc.

Sorting out "Shiga-toxin producing *E. coli*" (continued)

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STEC infection can be difficult to differentiate clinically from infection with many other common pathogens. Several studies have suggested that the risk of HUS is increased after treatment of STEC with antibiotics. If antimicrobial therapy is being considered for an enteric infection, obtaining a stool culture is important in guiding appropriate treatment.

By far the most commonly reported STEC strain in the U.S. is *E. coli* O157:H7. An important reason for this is that *E. coli* O157 is the only STEC which can be detected by culturing in most laboratories. Over 200 other se-

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Sorting out "Shiga-toxin producing *E. coli*" (continued)

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rotypes of *E. coli* also produce Shiga-toxins. Up to half of STEC-associated diarrhea in the U.S. may be due to non-O157 serotypes, though most of these likely go unreported due to limitations in laboratory testing. The most common non-O157 STEC serotypes in the U.S. include O26:H11, O111, O103, O121, and O145. In some parts of the world non-O157 STECs are a more common cause of diarrhea than O157.

The natural reservoir for *E. coli* O157 is infected ruminants; it can be found in up to half of cattle herds and 10% of cattle intended for human consumption. Not surprisingly, outbreaks have been associated with contaminated water, multiple different foods, and person-to-person spread.

Laboratory Diagnosis

Most clinical laboratories have the capacity to identify *E. coli* O157 by culture, isolating sorbitol-negative *E. coli* on SMAC agar. Many laboratories, however, do not regularly test for *E. coli* O157 as part of a routine stool culture. Some laboratories will test for *E. coli* O157 only on bloody stools, on request, or according to other internal protocols. It is important for clinicians to understand the testing protocols of their laboratories, in order to ensure appropriate testing and interpret results correctly.

Recently, several enzyme immunoassays for Shiga-toxin testing directly on stool specimens have become available. These tests have the advantage of being able to detect STEC serotypes in addition to just O157. Unfortunately, however, these tests do not result in isolation of the pathogen. Therefore, positive Shiga-toxin tests should be followed up with culturing and isolation of the organism, which can then be available for serotyping, DNA fingerprinting, or other confirmatory testing. By law, all laboratories must send *E. coli* O157 isolates or Shiga-toxin-positive specimens to the state laboratory for additional testing, which is provided free of charge. Pulsed-field gel electrophoresis (PFGE), a form of DNA fingerprinting, is routinely performed on all STEC specimens submitted to the Tennessee Department of Health State Laboratory. Resulting fingerprint patterns can help to identify cases with potential epidemiologic links to other sporadic cases, recognized outbreaks, or contaminated foods.

Advances in laboratory testing methods have the potential to increase recognition and reporting of STEC substantially. It is important that clinicians and laboratorians communicate about testing procedures and the interpretation of results, and ensure that specimens are forwarded to the state laboratory to ensure appropriate public health follow-up.

BY TIMOTHY F. JONES, MD

Deputy State Epidemiologist

Table 1. Common *E. coli* pathotypes that cause diarrhea.

Acronym	Pathotype	Epidemiology
ETEC	Enterotoxigenic *E. coli*	Leading cause of "traveler's diarrhea", common cause of childhood diarrhea worldwide. Contaminated food/water
EHEC / STEC	Enterhemorrhagic *E. coli*, aka Shiga-toxin producing E. coli	Includes *E. coli* O157. Contaminated food/water, person-to-person. Animal reservoirs. Associated with hemolytic-uremic-syndrome
EPEC	Enteropathogenic *E. coli*	Common cause of infant diarrhea in developing countries. Person-to-
EIEC	Enteroinvasive *E. coli*	Contaminated food/water. Endemic in developing countries.
EAEC	Enteroaggregative *E. coli*	Transmission unknown. Chronic diarrhea in developing countries, esp. children.

FoodNet: A Decade of Success

In 1996, the Centers for Disease Control and Prevention (CDC) under the auspices of the Emerging Infections Program embarked on an effort to minimize the impact of foodborne diseases in the United States. The Foodborne Diseases Active Surveillance Network (FoodNet) is designed to monitor foodborne illnesses in the United States using active surveillance methods. By using these methods, FoodNet is determining the burden of foodborne diseases, monitoring trends of foodborne illnesses over time, attributing the burden of foodborne illnesses to specific foods and settings and developing interventions to reduce the burden of foodborne illnesses.

In 1999, the Tennessee Department of Health joined FoodNet. Today, 10 state health departments along with the U.S. Department of Agriculture, the Food and Drug Administration and CDC make up FoodNet .

The Tennessee Department of Health Central Office FoodNet staff, Regional Health Department staff and 136 clinical laboratories work together to implement the FoodNet program in Tennessee. Central Office staff and Regional Health Department staff visit the clini-

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FoodNet: A Decade of Success (continued)

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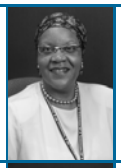
cal laboratories across the state to monitor selected foodborne pathogens identified in the laboratory. This active surveillance method improves the completeness of case finding and improves the timeliness investigations to identify any epidemiological links between cases.

Another important aspect of the FoodNet program is "special studies" performed to identify specific trends and attributes of foodborne illnesses. These studies provide important clues to the causes of foodborne illnesses and effective methods to prevent their recurrence. Recently, the Tennessee FoodNet site has performed special studies on the incidence of *Campylobacter* and *Salmonella* in infants, the spread of *E. coli* O157 in petting zoos, and the emergence of *Salmonella* serotypes in the population. Current studies include the incidence of new strains of *Clostridium difficile* in the community, and genetic factors associated with the development of Hemolytic Uremic Syndrome, a case control study of *E. coli* O157, and case control studies of emerging *Salmonella* serotypes. These studies will provide new knowledge to build sound public health policies.

The central office staff who are pictured below represent only a small subset of all who assist in the program. However, they are happy to discuss the program with anyone who is interested or needs to know more about foodborne illnesses.

BY LEONARD LINDSAY, MPH, MSN, RN
FoodNet Coordinator

	**Name:** Timothy F. Jones, MD **Title:** FoodNet Director, Principal Investigator Oversees all FoodNet projects and special studies		**Name:** Effie J. Boothe, MSN, RN **Title:** Nurse Consultant, Surveillance Officer **Studies:** *E. coli* O157 Cohort, HUS Surveillance
	**Name:** Samir Hanna, MD, MSPH **Title:** Epidemiologist, Surveillance Officer **Studies:** *Salmonella* Outcomes, Emerging Serotypes		**Name:** L. Amanda Ingram, MPH **Title:** Epidemiologist, Surveillance Officer **Studies:** *C. difficile* Enhanced Surveillance
	**Name:** Leonard Lindsay, MPH, MSN, RN **Title:** FoodNet Coordinator **Studies:** Genetic Predictors of HUS/STEC		**Name:** Marcy B. McMillian, MPH **Title:** Epidemiologist, Surveillance Officer **Studies:** Population Survey, Petting Zoo

YOU are invited!

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